SIZE ANALYSIS AND SEX RATIO OF JERDON'S BULL FROG *RANA CRASSA* JERDON (ANURA: RANIDAE)[1]

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(With eighteen text-figures)

A total of 324 specimens (103 females and 221 males) of Jerdon's bull frog *Rana crassa* were utilized in size and sex ratio analyses. The snout-vent length, femur length and weight of the females were 60.0 mm, 26.0 mm and 45 g (smallest) and 105.0 mm, 41.0 mm and 100 g (largest) respectively. The respective figures for males were 58.0 mm, 25.0 mm and 40 g (smallest) and 84.0 mm, 40.0 mm and 100 g (largest). Relationships between snout-vent length, femur length and weight were found to be linear. The sex ratio (male: female) was found to be 2.145:1.

INTRODUCTION

The amphibian fauna of India comprises about 201 described species, of which 55 species are included in the genus *Rana* (Inger and Dutta 1986, Chanda and Ghosh 1988, Das 1990). Of these, 3 (including *R. crassa*) are commercially valuable. The distribution of the species is localised in India (Boulenger 1920, Bhaduri 1944, Daniel 1975, Dutta and Mohanty-Hejmadi 1976, Chopra and Kumar 1977). *Rana crassa* is distributed extralimitally in Sri Lanka (Kirtisinghe 1957). Little is known on the morphometrics and sex ratio of the Indian amphibians, especially the edible species. A recent study by Mohanty-Hejmadi and Dutta (1981) is on the sex ratio and size correlation of *R. tigerina* from eastern India. Abdulali (1986) studied the sex ratio of *R. tigerina* from western India. However, no such data is available on *R. crassa*, which is found in sympatry with *R. tigerina* in Orissa.

MATERIAL AND METHODS

Specimens were collected from several localities in Orissa during different months of the year between 1976-1981 and 1986-1987. A total of 324 specimens (103 females and 221 males) have been utilized in this study. The snout-vent length (SVL) and the femur length of 163 *R. crassa* were measured. Data on weight of 111 males and 52 females obtained were used. For some years, data on weight was not available (Tables 1, 2). Sexing was done by examining the sexual dimorphism and examination of gonads. All morphometric variables were compared with each other by plotting graphs. Statistical analysis such as correlation coefficient (r), regression coefficient (mm), regression equation (Y = mx + c) were done.

RESULTS

Size analysis of females: The total number of gravid females collected from 1978 to 1981 and during 1986 was 103. Of these specimens, the SVL and femur length of the smallest gravid female were 60.0 and 26.0 mm respectively. However, the lowest weight of a female frog was 45 g (SVL 64.0 mm). The SVL and femur length of the largest gravid female were 105.0 and 41.0 mm respectively and the maximum weight of a gravid female was 100 g. Cumulative data indicates that the highest and lowest mean of SVL and femur length were 76.8 ± 2.167, 33.75 ± 3.429 mm and 92.833 ± 7.733, 36.0 ± 3.316 mm respectively. The cumulative data on weight suggest the maximum and minimum mean weight to be 82.777 ± 9.428 and 73.5 ± 12.216 g respectively (Table 1). The

[1]Accepted June 1990.

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TABLE 1

SNOUT VENT (S-V) LENGTH, FEMUR LENGTH AND WEIGHT OF *R. crassa* FEMALES IN DIFFERENT YEARS

Year of Collections	No.of individuals	(S-V) length (mm) Range	(S-V) length (mm) Mean ± S.D.	Femur length (mm) Range	Femur length (mm) Mean ± S.D.	Weight (g) Range	Weight (g) Mean ± S.D.
1978	6	85-105	92.833 ±7.33	32-41	36	—	—
1979	18	73-91	80.055± 4.721	29-40	34.666± 4.432	70-100	82.777± 9.428
1980	24	60-89	77.916± 6.613	26-39	33.75 ± 3.429	55-95	78.333±11.389
1981	5	75-80	76.8 ± 2.167	33-38	35.6 ± 2.073	75-85	80 ± 3.538
1986	50	64-88	76.82 ± 6.454			45-100	73.5 ±12.216

Weight data for 1978 not available.

TABLE 2

SNOUT-VENT (S-V) LENGTH, FEMUR LENGTH AND WEIGHT OF *R. crassa* MALES IN DIFFERENT YEARS

Year of Collection	No.of individuals	(S-V) length (mm) Range	(S-V) length (mm) Mean ± S.D.	Femur length (mm) Range	Femur length (mm) Mean ± S.D.	Weight (g) Range	Weight (g) Mean ± S.D.
1976	6	74—84	78.833 ± 4.622	33—39	37.333 ± 2.16	—	—
1977	2	75—83	79 ± 5.565	26—30	28 ± 2.828	—	—
1978	17	62—80	71.941 ± 4.007	26—37	30.235 ± 3.345	—	—
1979	31	60—82	67.387 ± 5.902	25—40	28.677 ± 3.448	45—9 0	55.483 ± 10.275
1980	42	60—82	67.0 ± 5.552	25—38	28.023 ± 2.797	40—100	53.333 ± 12.428
1981	13	60—70	63.923 ± 3.303	26—30	27.384 ± 1.386	45—75	51.538 ± 7.741
1986	110	58—74	64.284 ± 4.072	—	—	40—75	47.629 ± 8.258

Weight data for 1976-78 not available.

relationship between SVL, femur length and weight of all the female frogs of different years are shown in Figs. 5-7, 11-13 and 18.

During 1979, a total of 18 specimens were collected. These showed positive correlations between SVL and femur length (r = 0.754, linear, Y = 0.707x–21.932) (Fig. 5), between SVL and weight (r = 0.762, Y = 1.522x–39.066) (Fig. 6), and between femur length and weight (r = 0.271, Y = 0.994x + 47.541) (Fig. 7). During 1980, a total of 24 individuals were collected. Linear relationships were seen between SVL and femur length (r = 0.777, Y = 0.465x–2.48) (Fig. 11), between SVL and weight (r = 0.854, Y = 1.388x–29.814) and between femur length and weight (r = 0.779, Y = 2.878x–18.799) (Figs. 12, 13). During 1981, only 5 specimens were collected. Due to lack of data on SVL, only relationship between femur length and weight was examined, and found to be linear (r = 0.682, Y = 1.162x + 38.605). During 1986, a total of 50 specimens were collected and the relationship between SVL and weight was linear (r = 0.692, Y = 1.311x–27.211) (Fig. 18).

Size analysis of males: From 1976 to 1981 and during 1986, a total of 221 mature male *R. crassa* were collected. The lowest SVL, femur length and weight recorded were 58.0 mm, 25.0 mm and 40 g respectively. The highest SVL, femur length and weight recorded were 84.0 mm, 40.0 mm and 100 g respectively (Table 2).

As only six and two specimens were collected between 1976-1977, no correlation was made for any of the parameters used in the study. However, from 1978 to 1981, and during 1986, the number of specimens collected were 17, 31, 42, 13 and 110 respectively and the correlation between SVL with femur length, SVL

TABLE 3

SEX RATIO OF *Rana crassa*

Year of collection	Total No. collected	No. of males	No. of females	Sex ration (Male : Female)
1976	6	6	—	—
1977	2	2	—	—
1978	23	17	6	17 : 6 (2.83 : 1)
1979	49	31	18	31 : 18 (1.722 : 1)
1980	66	42	24	42 : 24 (1.75 : 1)
1981	18	13	5	13 : 5 (2.6 : 1)
1986	160	110	50	110 : 50 (2.2 : 1)
Cumulative :	324	221	103	(2.145 : 1)

with weight and femur length with weight for each year was found to be linear (Figs. 1-4, 8-10 and 14-17).

Sex ratio: During 1976 and 1977, only 8 males were collected and thus it was not possible to obtain sex ratios for these years. Sex ratios (male: female) among specimens collected in 1978, 1979, 1980, 1981 and 1986 varied from a minimum of 1.722:1 in 1979 (49 specimens: 31 males, 18 females) to a maximum of 2.83:1 in 1978 (23 specimens: 17 males, 6 females). The cumulative data for all the years indicate the sex ratio (male: female) to be 2.145:1 (Table 3).

Discussion

Size variation between sexes in *R. crassa* is one of the diagnostic characteristics of sexual dimorphism. Similar kind of observation has been obtained by Mohanty-Hejmadi and Dutta (1981) for *R. tigerina*. However, *R. tigerina* is comparatively larger than *R. crassa*. Due to similarities in several external morphological characteristics, *R. crassa* was considered as a subspecies of *R. tigerina* (Boulenger 1920, Kirtisinghe 1957). For the first time, the present study provides data on the size variability between *R. crassa* and *R. tigerina*. The relationship between the different morphological measurements of *R. crassa* was found to be linear, which is comparable with that of *R. tigerina* (Mohanty-Hejmadi and Dutta 1981).

Data on sex ratio indicates that males outnumber females, as is the case for most amphibian species found in Orissa (Dutta, unpublished data). When compared with the sex ratio of *R. tigerina* (Dutta 1979, Mohanty-Hejmadi and Dutta 1981, Abdulali 1986), it is interesting to note that Dutta (1979) and Mohanty-Hejmadi and Dutta (1981) reported more males than females of *R. tigerina,* which is comparable to that in *R. crassa*. However, Abdulali (1986) reported more females than males for *R. tigerina*. This may be due to regional variation as Abdulali conducted his studies in western India.

When the data obtained by Mohanty-Hejmadi and Dutta (1981) and Abdulali (1986) on *R. tigerina* were pooled, the sex ratio (male: female) was found to be almost 1:1. However, in the present study, the sex ratio (male: female) of *R. crassa* was 2.145:1 (Table 3). Hence, one finds variations between sex ratios of the two species. It is concluded that the presence of more males of *R. crassa* in nature leads to keen competition between the males to mate with the females. Perhaps this also ensures successful breeding of this species.

Acknowledgements

One of us (P.M.) would like to thank the University Grants Commission for a Junior Research Fellowship. Partial financial support from the Department of Environment and Forests, Government of India to S.K. Dutta is gratefully acknowledged.

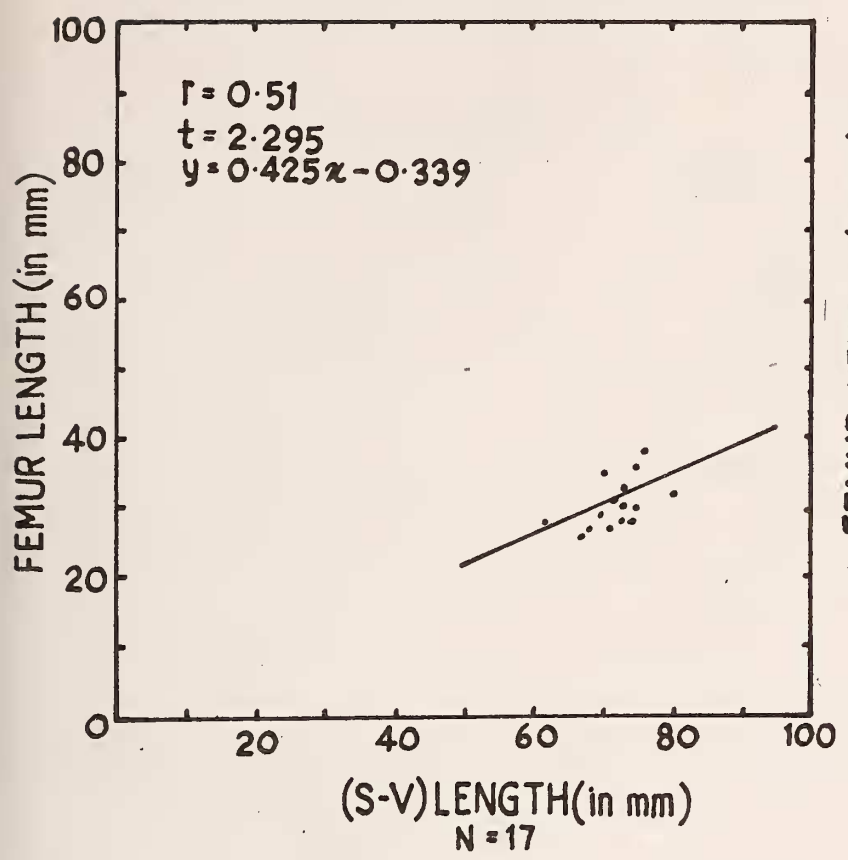

Fig. 1. Relationship between (S-V) length and femur length of male *Rana crassa* in 1978.

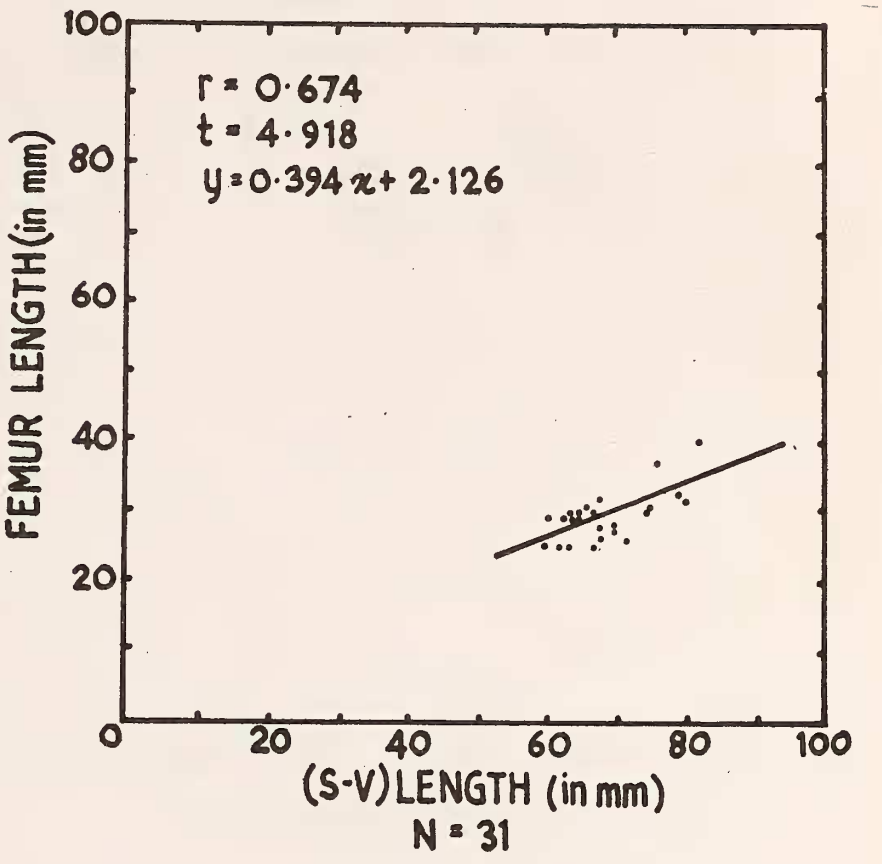

Fig. 2. Relationship between (S-V) length and femur length of male *Rana crassa* in 1979.

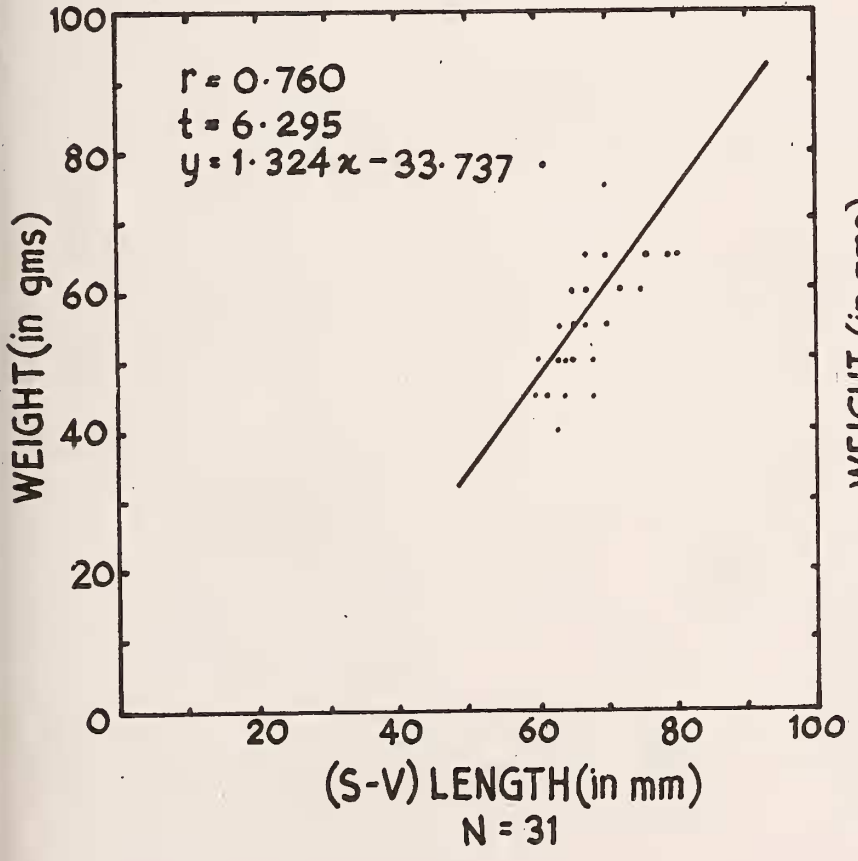

Fig. 3. Relationship between (S-V) length and weight of male *Rana crassa* in 1979.

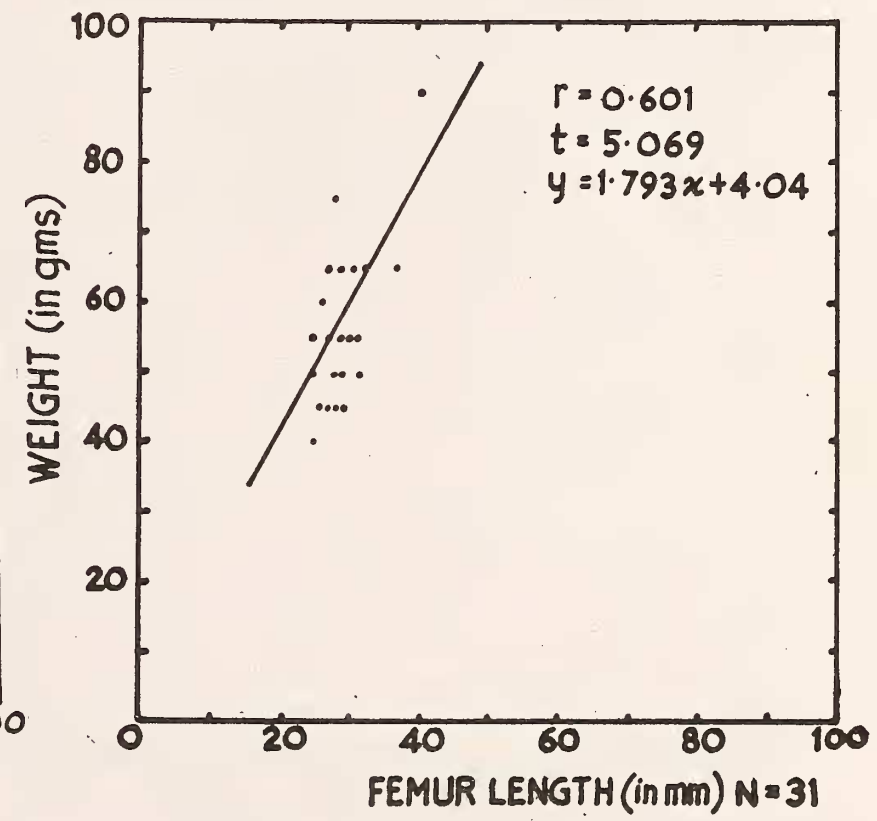

Fig. 4. Relationship between femur length and weight of male *Rana crassa* in 1979.

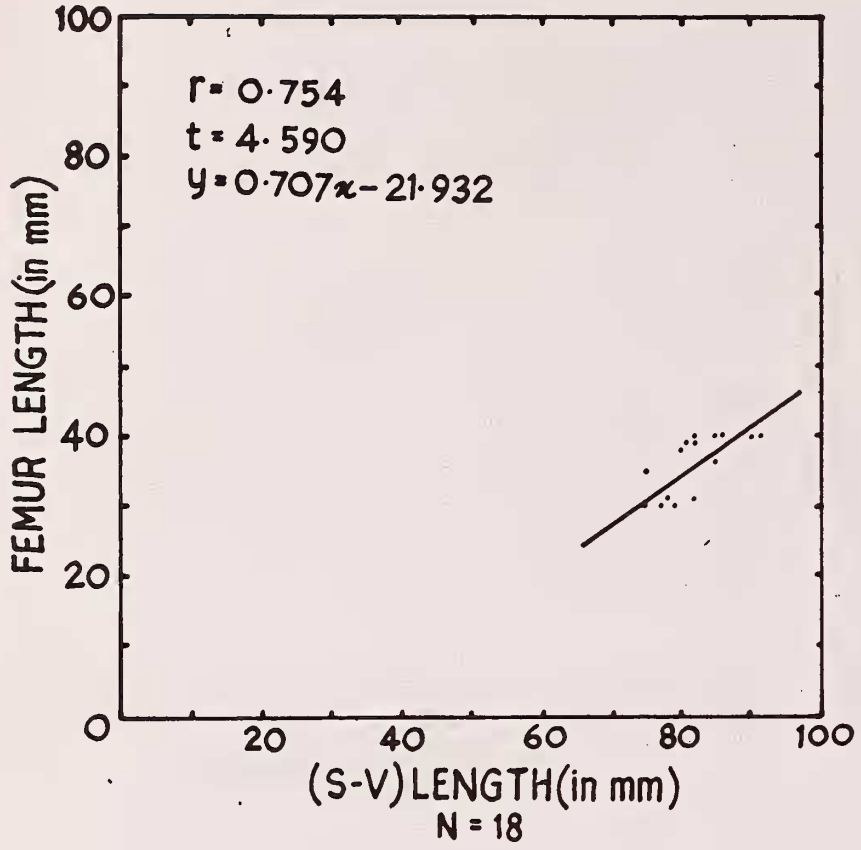

Fig. 5. Relationship between (S-V) length and femur length of male *Rana crassa* in 1979.

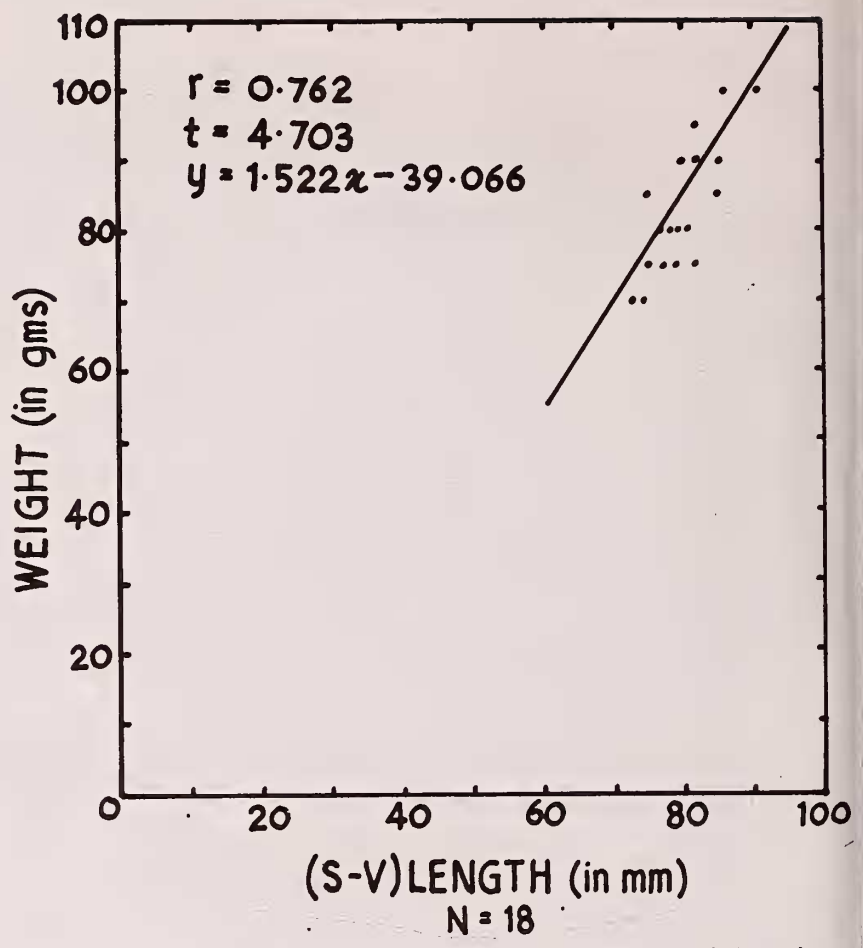

Fig. 6. Relationship between (S-V) length and weight of female *Rana crassa* in 1979.

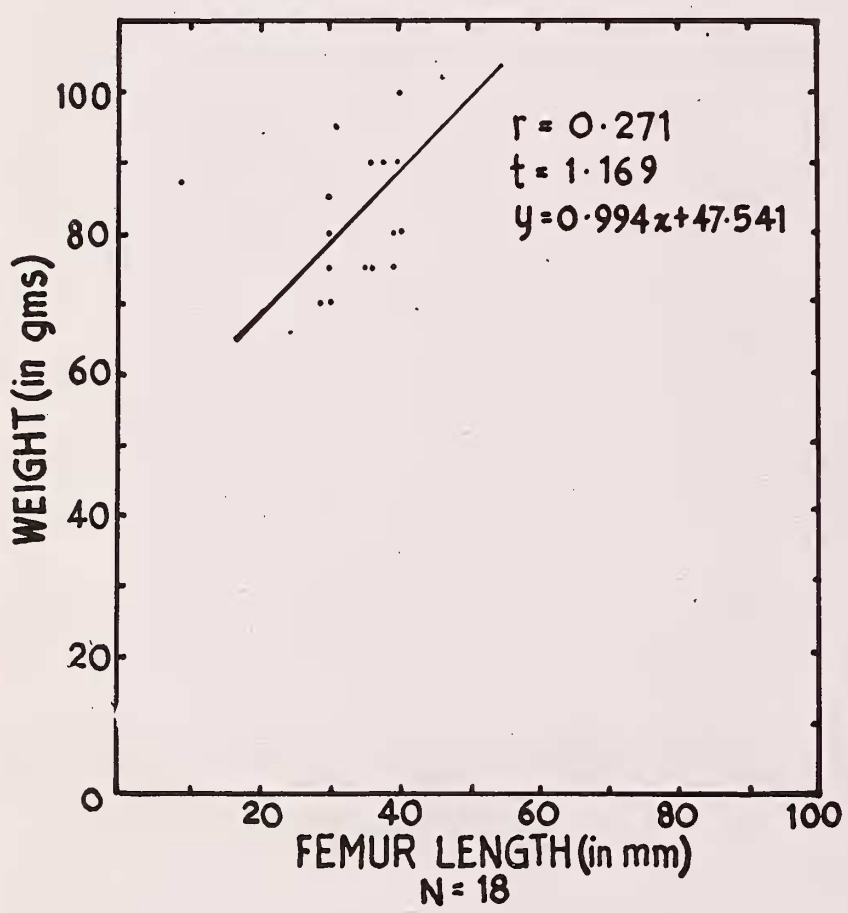

Fig. 7. Relationship between femur length and weight of female *Rana crassa* in 1979.

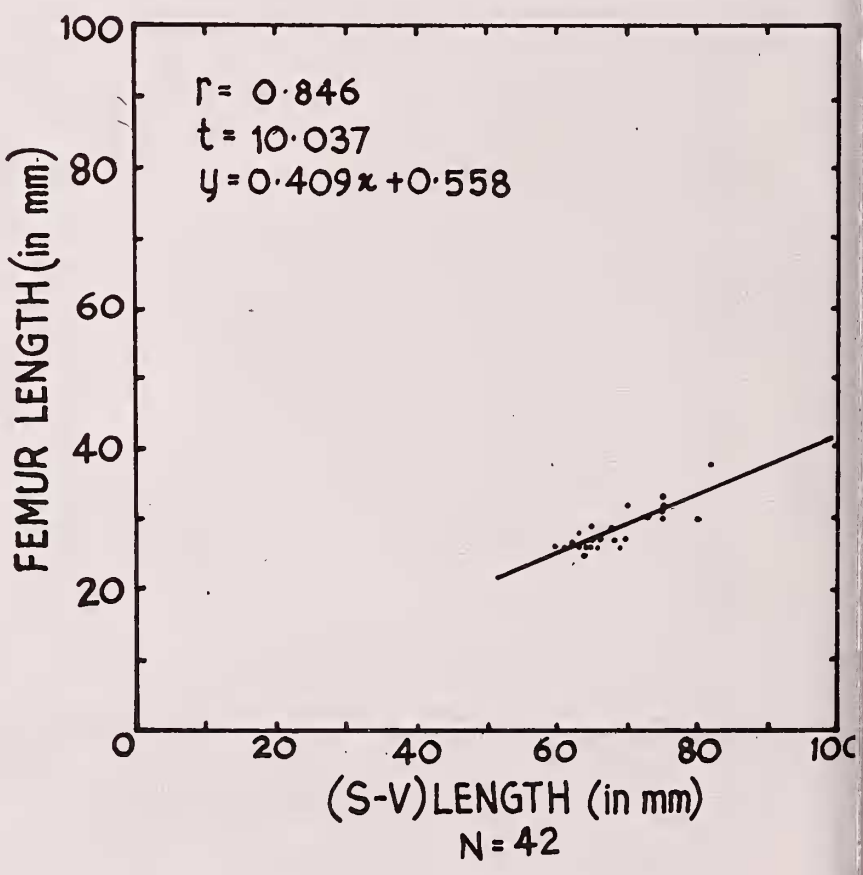

Fig. 8. Relationship between (S-V) length and femur length of male *Rana crassa* in 1980.

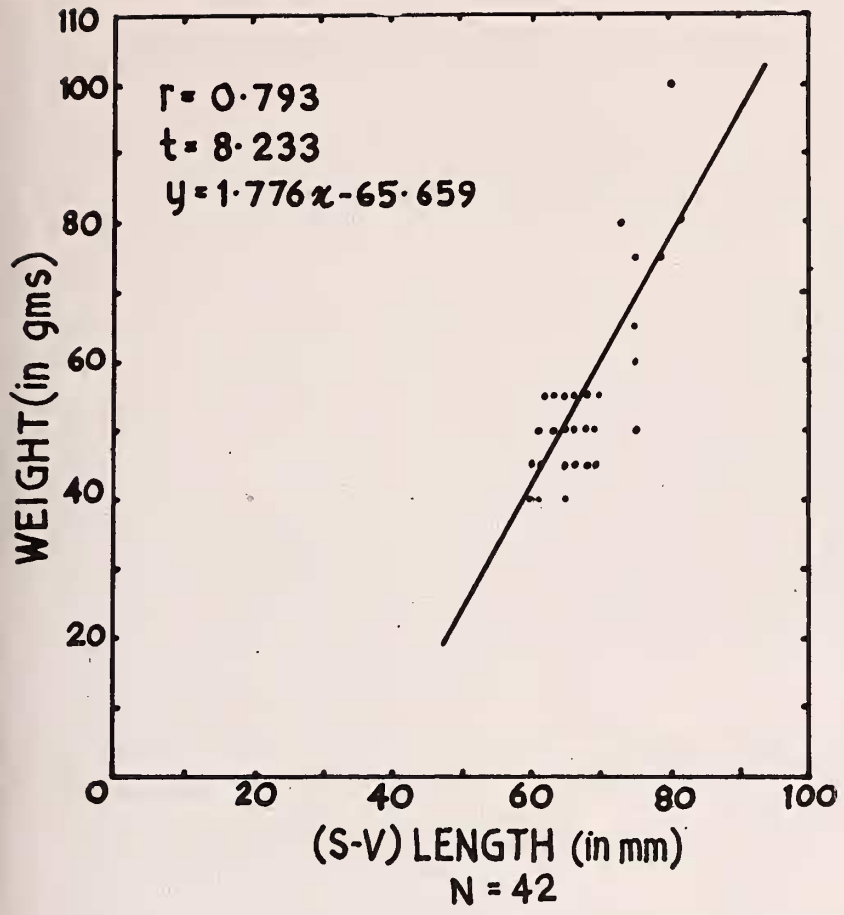

Fig. 9. Relationship between (S-V) length and weight of male *Rana crassa* in 1980.

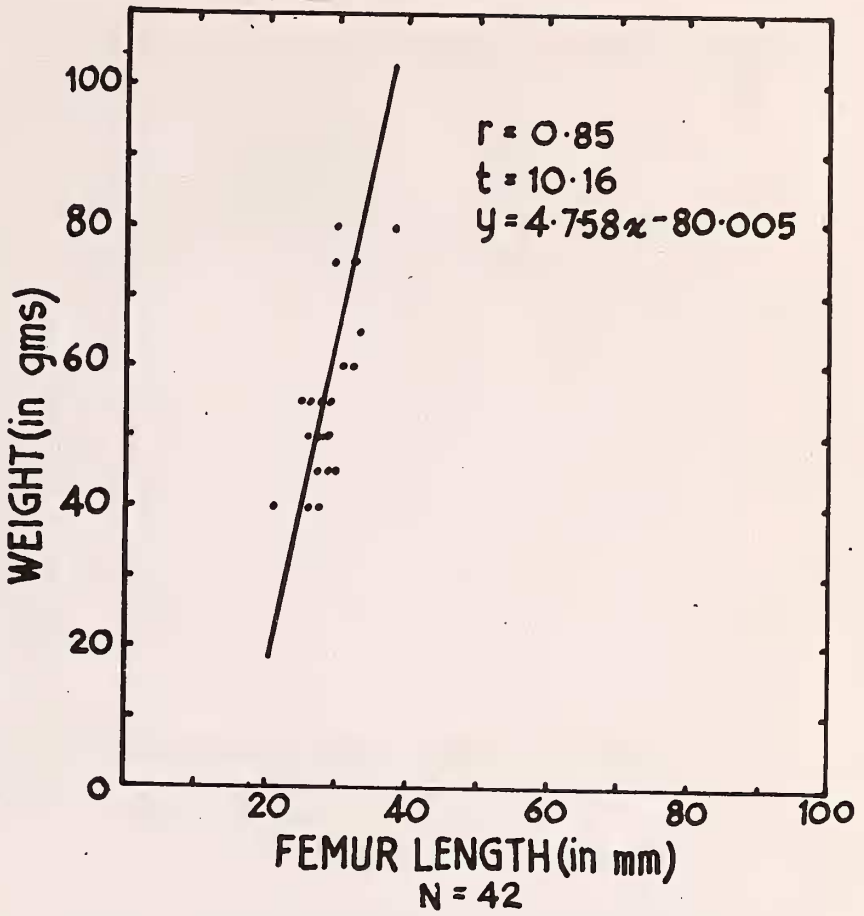

Fig. 10. Relationship between femur length and weight of male *Rana crassa* in 1980.

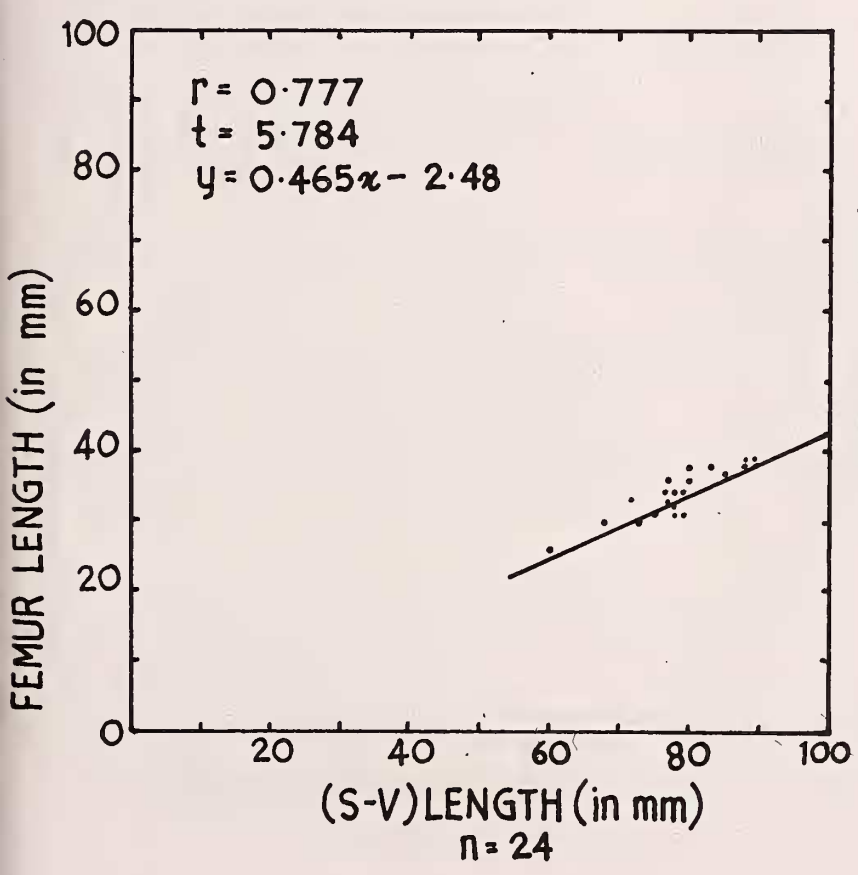

Fig. 11. Relationship between (S-V) length and femur length of female *Rana crassa* in 1980.

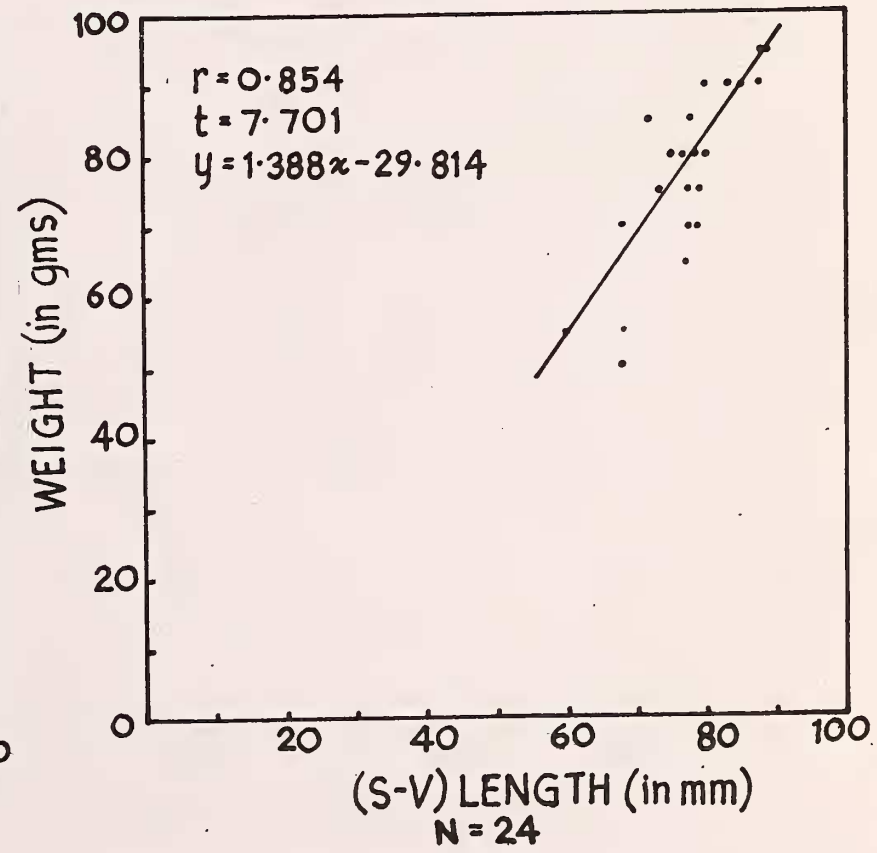

Fig. 12. Relationship between (S-V) length and weight of female *Rana crassa* in 1980.

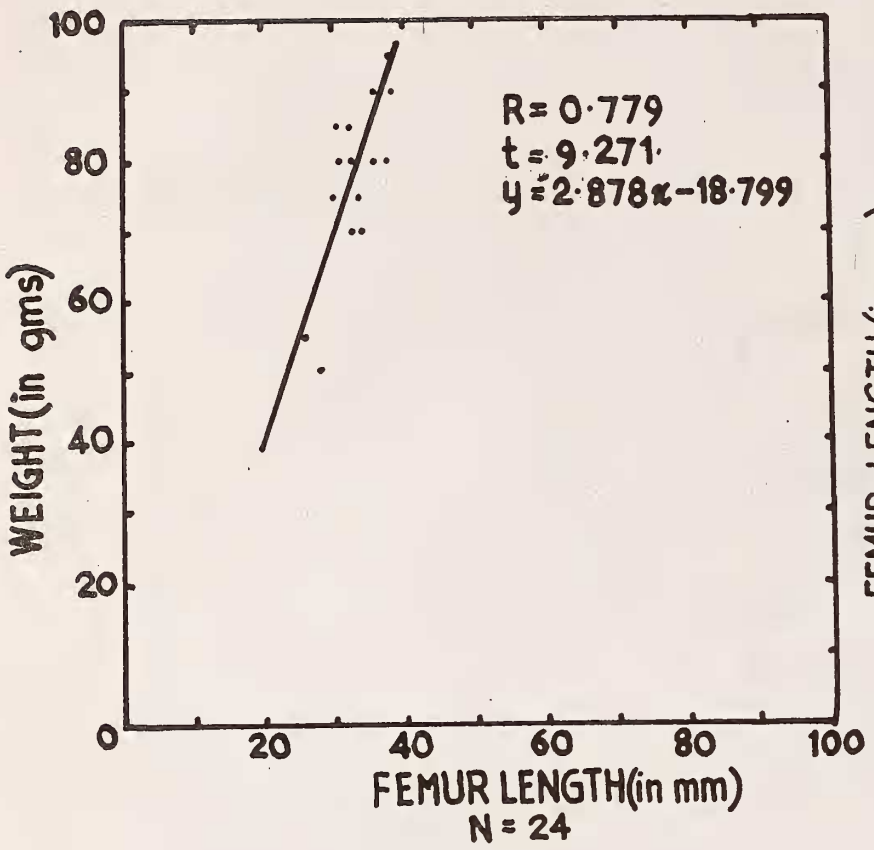

Fig. 13. Relationship between femur length and weight of female *Rana crassa* in 1980.

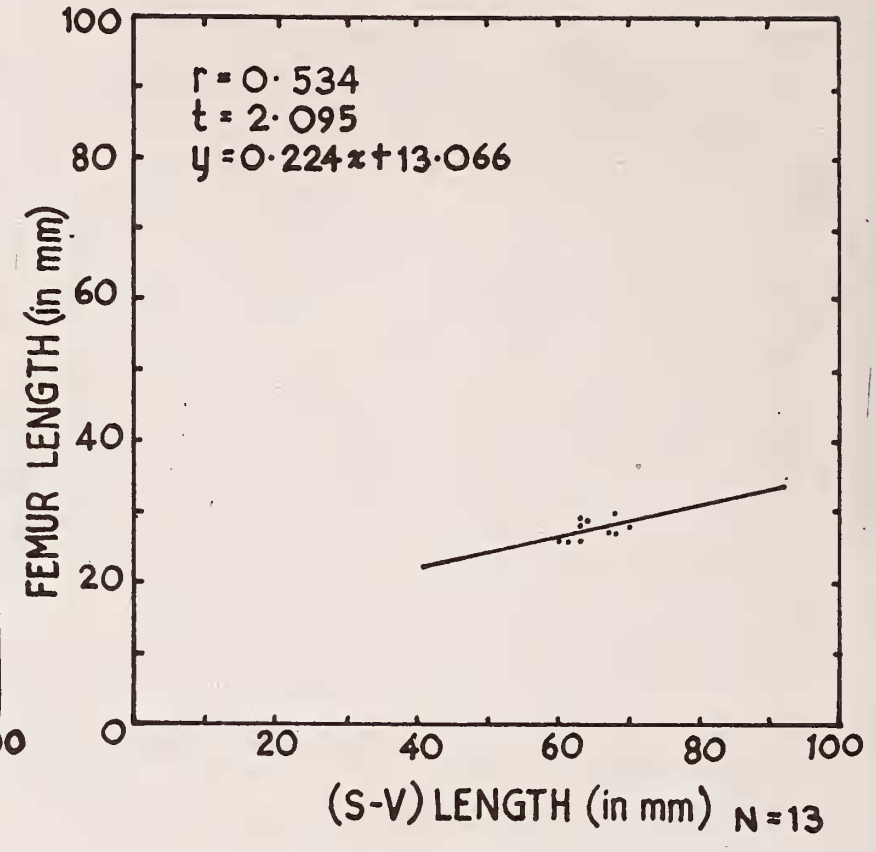

Fig. 14. Relationship between (S-V) length and femur length of male *Rana crassa* in 1981.

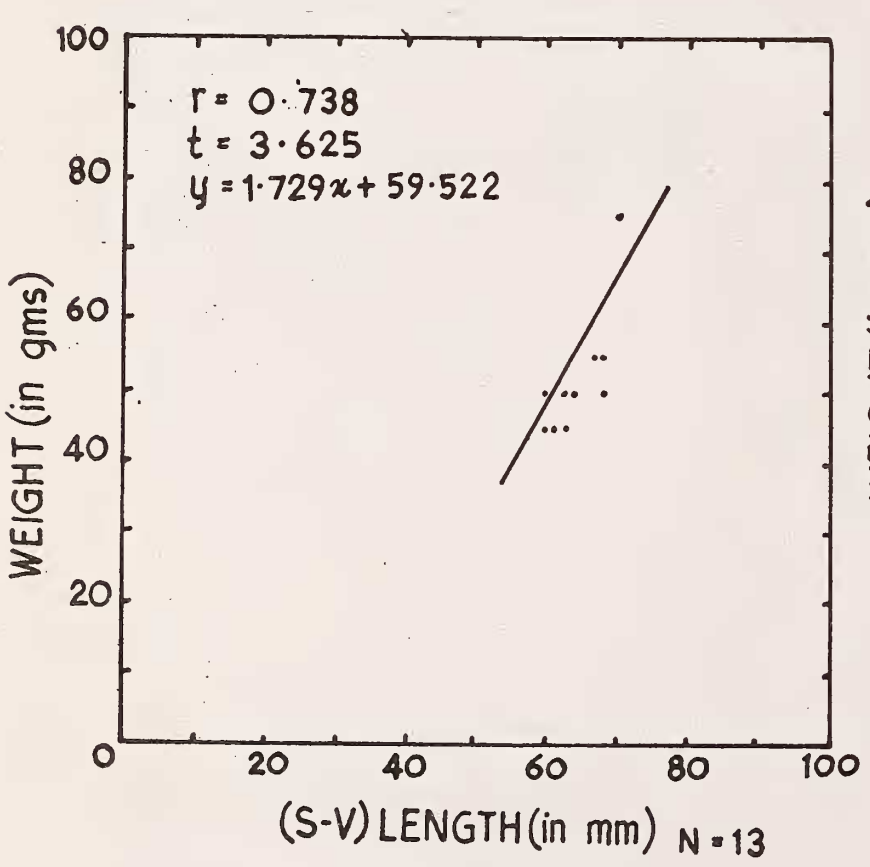

Fig. 15. Relationship between (S-V) length and weight of male *Rana crassa* in 1981.

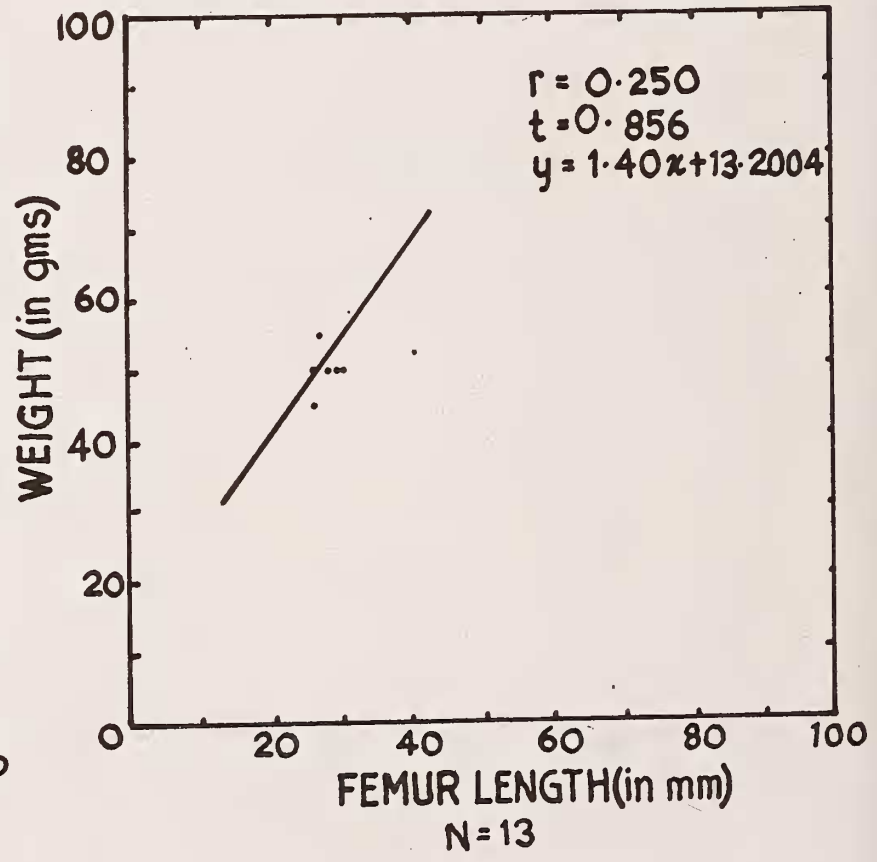

Fig. 16. Relationship between femur length and weight of male *Rana crassa* in 1981.

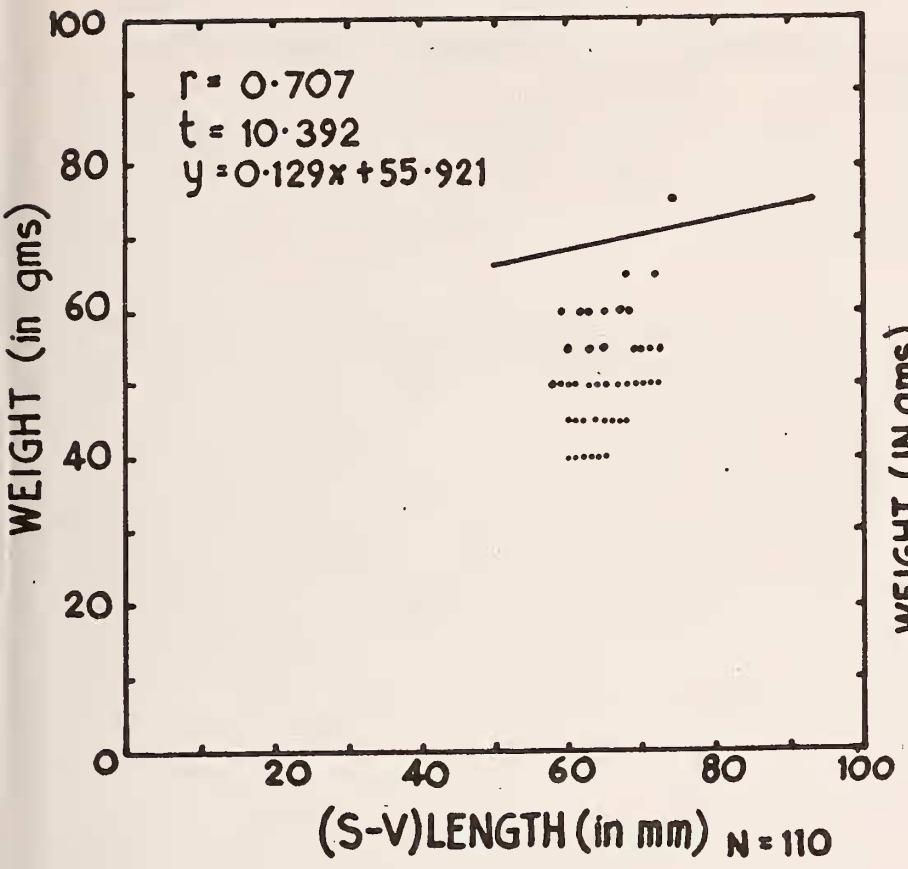

Fig. 17. Relationship between (S-V) length and weight of male *Rana crassa* in 1986.

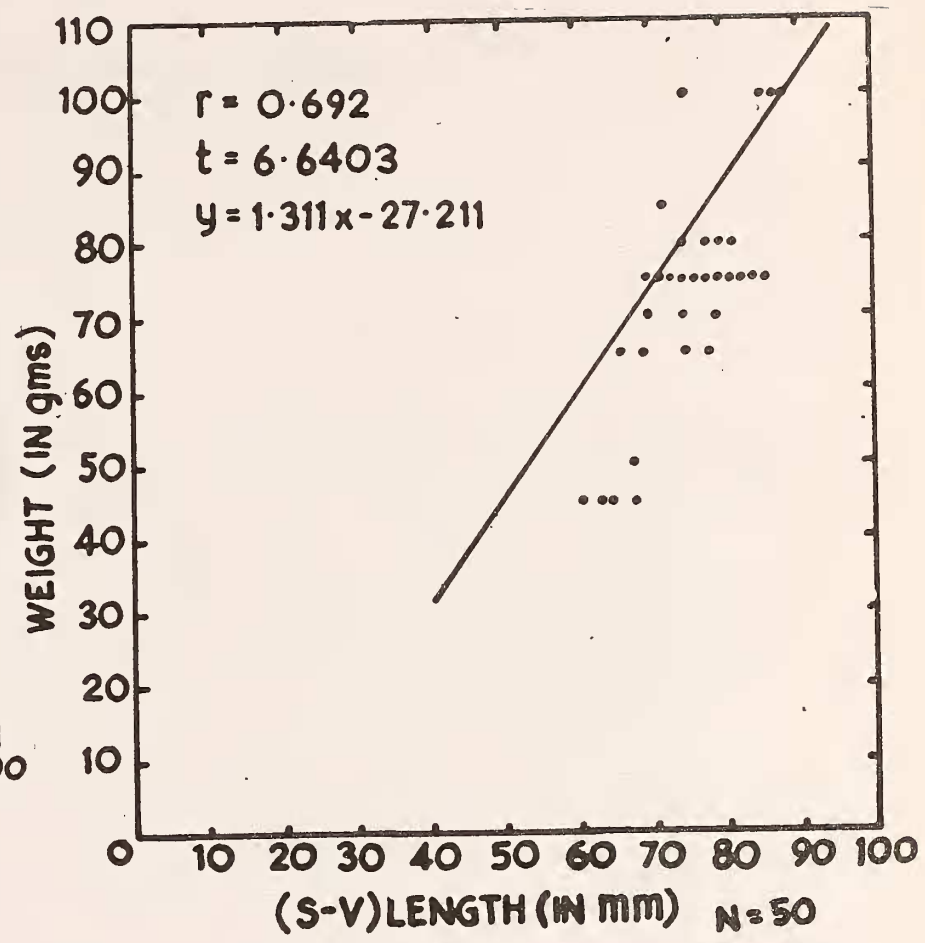

Fig. 18. Relationship between (S-V) length and weight of female *Rana crassa* in 1986.

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